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NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
WABAN HILL RESERVOIR. (U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV FEB 80

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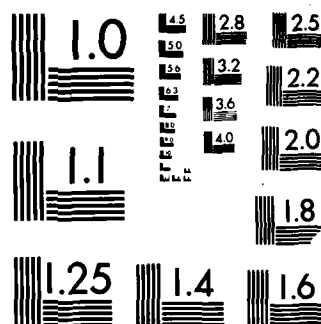
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AD-A155 790

CHARLES RIVER BASIN
NEWTON, MASSACHUSETTS

WABAN HILL RESERVOIR DAM
MA 01111

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The embankment surrounds the reservoir for a distance of about 1100 ft. The dam is small in size with a hazard potential of high. The dam is judged to be in fair condition at the present time owing to the apparently inoperative lower sluice gate, riprap failures in the interior face and excessive vegetation on the interior and exterior faces.		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

JUL 07 1980

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Waban Hill Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, Metropolitan District Commission, Boston, Massachusetts 02109.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,


MAX B. SCHEIDER

Colonel, Corps of Engineers
Division Engineer

Incl
As stated

WABAN HILL RESERVOIR DAM

MA 01111

CHARLES RIVER BASIN

CANTON, MASSACHUSETTS

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.: MA 01111
Name of Dam: Waban Hill Reservoir Dam
Town: Newton
County and State: Middlesex County, Massachusetts
Stream: Offstream
Date of Inspection: October 23, 1979

BRIEF ASSESSMENT

Waban Hill Reservoir Dam is an 80-year old earth embankment structure used to impound water for the City of Boston water distribution system. The embankment nearly surrounds the reservoir for a distance of approximately 1,100 feet. The interior face of the reservoir is protected with hand placed riprap blocks constructed on a 1H:IV slope. The 17-foot wide crest and 1.5H:IV slope of the exterior face of the embankment is covered with grass and a few small trees and bushes. A stone masonry gate house, equipped with high and low level sluice gates, is located at the southwest corner of the reservoir.

The surface area of the reservoir on the date of the inspection was about 1.9 acres. The drainage area for the dam is the surface area of the reservoir at the crest of the dam which is 2.9 acres. The maximum storage to the top of the dam is about 58 acre-feet and the maximum height is approximately 28 feet; therefore the size classification is "Small". A breach of the dam would affect an urban residential neighborhood. The dam has been classified as having a "High" hazard potential. Based on the "Small" size and "High" hazard potential, the range for the test flood is one-half of the Probable Maximum Flood (PMF) to the full PMF. The recommended test flood would be the full PMF. Since no inflow from the drainage area runoff occurs at Waban Hill Reservoir, the full Probable Maximum Precipitation (PMP) was considered the test flood and was applied directly to the normal pool surface area.

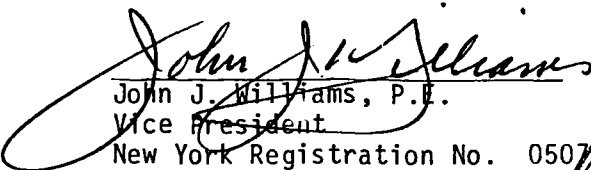
The dam is judged to be in fair condition at the present time owing to the apparently inoperative lower sluice gate, riprap failures on the interior face and excessive vegetation on the interior and exterior faces. At the time of inspection, the reservoir was drawn down for maintenance operations. Consequently, the condition of the riprap on the interior face was readily observable, but exterior toe-of-dam seepage may have gone undetected because of the low water level in the reservoir.

The test flood for the facility is 22.9 inches of rainfall falling directly on the reservoir. The maximum pool, when the reservoir is in use, is normally

maintained at least 2 feet below the crest; therefore, chances are extremely remote that the crest of the dam will ever be overtopped.

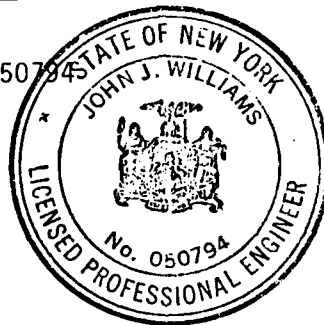
Within one year after receipt of this Phase I Inspection Report, the Owner, the Metropolitan District Commission (MDC), should engage a qualified registered professional engineer to: (1) investigate the seismic stability of the dam; (2) inspect the dam for seepage during the full pool condition. The MDC should implement the following operation and maintenance measures: (1) develop a formal surveillance and flood warning plan; (2) institute a program of annual technical inspection; (3) develop and adhere to a comprehensive maintenance program; (4) put the low level sluice gate, stage recorder and gate hoists in operable condition; (5) remove excessive vegetation from the interior and exterior faces; and (6) repair the riprap failures on the interior face.

O'BRIEN & GERE ENGINEERS, INC.


John J. Williams, P.E.
Vice President

New York Registration No. 050794

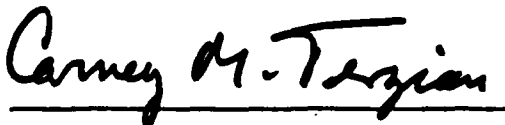
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This Phase I Inspection Report on Waban Hill Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.



ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division



CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division



RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:



JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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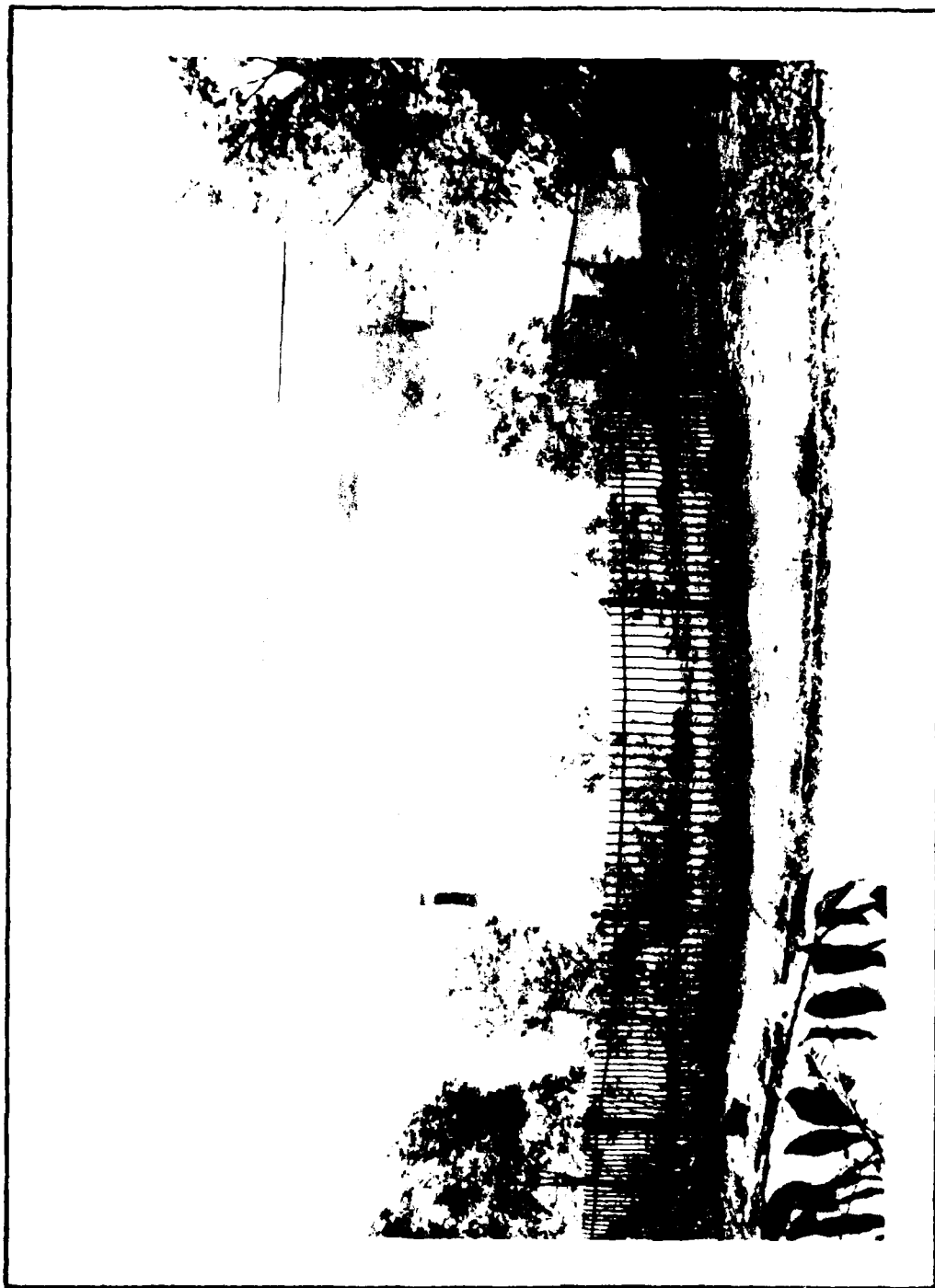
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LOOKING SOUTHWEST AT THE WABAN HILL RESERVOIR DAM FROM THE NORTHEAST CORNER OF THE
RESERVOIR. (10/23/79)

3. Develop and adhere to a comprehensive maintenance program.
4. Put the low level sluice gate, stage recorder and gate hoists in operable condition.
5. Remove excessive vegetation from the interior and exterior faces.
6. Repair the riprap failures on the interior face.

7.4 Alternatives

No valid alternatives to the recommendations described above are considered feasible for this site.

SECTION 7

ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon the visual inspection of the site on October 23, 1979, Waban Hill Reservoir appears to be in fair condition. No signs of settlement, cracking, or other structural movement were observed on the crest or exterior face of the embankment. A few bushes were observed on the exterior face. However, on the interior face many riprap blocks are displaced, primarily at approximately 6 feet below the crest. Other areas of displaced blocks were observed at random locations on the remainder of the interior face.

The condition of the equipment located in the gatehouse is generally poor. The low level sluice gate and stage level recorder do not appear to be operable and the valve stems are very corroded. The chlorination facilities will also require some repair prior to putting the reservoir back into service. Inlet screens, in the gatehouse however, appear to be new.

b. Adequacy of Information. Information obtained during the field investigation of the reservoir and material obtained from the MDC, are considered adequate to conduct a Phase I dam evaluation. It is noted, however, that seepage problems may have gone undetected because of the low water level in the reservoir.

c. Urgency. The recommendations and remedial measures described in this Section should be implemented within one year from the date of receipt of this Report.

7.2 Recommendations

The MDC should engage a qualified registered professional engineer to: (1) investigate the seismic stability of the dam utilizing conventional equivalent static load methods, and (2) inspect the dam for seepage during full pool conditions.

7.3 Remedial Measures

a. Operation and Maintenance Procedures. The MDC should implement the following operation and maintenance measures:

1. Develop a formal surveillance and flood warning plan.
2. Institute a program of annual technical inspection.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

At the time of inspection, no signs of settlement, cracking, or other structural movement were observed. The interior and exterior faces of the embankment were readily observable since the reservoir was drawn down for maintenance reasons. Underwater areas were not inspected.

The most notable deficiency observed was displacement of riprap, primarily around the periphery of the reservoir at approximately 6 feet below the crest. This condition appears to have been caused by ice action. Other areas of riprap displacement were noted at random locations on the interior of the embankment face.

6.2 Design and Construction Data

Original design and construction data for Waban Hill Reservoir is not available, according to representatives of the MDC. It is estimated that the reservoir was built about 1900.

6.3 Post Construction Changes

No changes have been made to the original structure, according to representatives of the MDC.

6.4 Seismic Stability

Waban Hill Reservoir is located in Seismic Zone 3 on the "Seismic Zone Map of Contiguou States". Therefore, according to the Recommended Guidelines for Phase I Safety Inspection of Dams, a seismic stability analysis should be performed as recommended in Section 7.

The assumed failure would be a result of piping or undermining of the embankment. Downstream hazard areas to the north and south of the reservoir were studied because routing of flood waters could occur in either direction, depending upon the location of the assumed breach. The hazard areas consist of urban neighborhoods in close proximity to the reservoir. Failure of the reservoir embankment could result in a maximum floodwater discharge of approximately 740 cfs with associated flow depths of 2.2 and 1.8 feet for impact areas to the north and south, respectively. Depths of flow in the first floors of the residences would essentially be the same while basement apartments would be entirely filled with the floodwaters.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Waban Hill Reservoir is not located on a stream and is filled by direct rainfall and/or pumping of water from the Chestnut Hill Reservoir. The structure is provided with no spillway. The region draining into the reservoir consists only of that area bounded by the embankment and the natural ground interior slope located at the northeast corner of the reservoir.

5.2 Design Data

Information with regard to the original hydraulic and hydrologic design of the reservoir is not available, according to Mr. Thompson of the MDC.

5.3 Experience Data

Reservoir pool elevation records have been recorded by the MDC and are available at their main office. According to Mr. Thompson of the MDC, the embankment has never been overtopped.

5.4 Test Flood Analysis

Based on the "Small" size and "High" hazard potential, the range for the test flood is one-half of the Probable Maximum Flood (PMF) to the full PMF. Because the reservoir is surrounded by an urban residential neighborhood, the recommended test flood would be the full PMF. Since no runoff occurs at Waban Hill Reservoir, the full Probable Maximum Precipitation (PMP) was considered the test flood and was applied directly to the normal pool surface area.

An occurrence of the test flood would cause the elevation of the pool level to rise 22.9 inches (see Appendix D). Since the freeboard is normally greater than 2 feet, and the stage in the reservoir can be controlled by MDC personnel, it is unlikely that the reservoir would overtop during a test flood event.

5.5 Dam Failure Analysis

The dam failure analysis was performed using the HEC-1-DB computer program. The following assumptions were made for the analysis:

- a) Water in the reservoir was assumed to be at the crest of the dam, Elev. 262.2.
- b) A breach width of 200 feet was assumed.
- c) The assumed time of breach failure was one hour.

SECTION 4

OPERATION AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Waban Hill Reservoir is currently out of service; consequently, no operating procedures are in effect. When the reservoir is ready to be put back into service the operator must open valves to allow water to be pumped into the reservoir from the Chestnut Hill Reservoir. Then, once the sluice gates, chlorination facilities and level recorder are made operational, gates at the outflow structure must be opened to permit discharge to the City of Boston distribution system.

b. Description of Any Warning System in Effect. According to Mr. William Thompson of the Distribution Section of the MDC, no warning system is currently in effect.

4.2 Maintenance Procedures

a. General. At the time of inspection, the reservoir was out of service for maintenance operations. According to Mr. William Thompson, debris was being removed from the bottom of the reservoir to help improve water quality. As of January 8, 1980, Mr. Thompson was waiting for the chemist's report to see if conditions have improved to the point where the reservoir may be put back into service.

b. Operating Facilities. Occasional maintenance of chlorination facilities, sluice gates, and valves is performed as the need arises, according to Mr. Thompson.

4.3 Evaluation

The current maintenance program does not appear to have provided for proper care of mechanical equipment in the gatehouse. From visual observation, it appears that the stage elevation recorder and low level gate are not operable.

Scattered bushes should be removed from the exterior face of the embankment and the crest. The interior face of the embankment on the other hand, is in need of extensive replacement of displaced riprap.

d. Reservoir Area. The reservoir area is restricted to that area bounded by the embankment crest and the northeast corner abutment. The entire perimeter of the reservoir is riprapped lined. Sediment accumulation in the reservoir appears to be minimal.

e. Downstream Channel. Discharge from the reservoir is via a 20-inch cast iron pipe connecting with the City of Boston water distribution system and an 8-inch diameter drain. There are no channels provided to convey flood waters from the reservoir.

3.2 Evaluation

There were no visual signs of structural deficiency at the time of inspection. The embankment, for the most part, appeared to be well-maintained and in good condition. No signs of seepage were observed, but it must be noted that the depth of water in the reservoir at the time of the inspection was only 4 feet.

Displacement of riprap on the interior face of the embankment and the presence of some small bushes on the interior and exterior faces of the embankment appear to be the only conditions which need to be corrected. Recommendations with regard to improving these conditions are presented in Section 7.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Waban Hill Reservoir was inspected on October 23, 1979. At the time of the inspection, the reservoir was not in service and the depth of water in the reservoir was only 4 feet. Underwater areas were not inspect .

Observations and comments made during the field inspection appear on a checklist included as Appendix A of this report.

b. Dam. The embankment was observed to have the following major features:

1. The exterior face of the embankment is sloped approximately 1.5H:IV and is well covered with grass. Except for the presence of a few bushes, the exterior face appears to be in good condition.

2. The top width of the embankment is approximately 17 feet. It is well-maintained, with no evidence of cracking, settlement or other visible deficiency.

3. The interior embankment slope is approximately 1H:IV and is protected with cut stone riprap. The riprap is underlain by a layer of coarse gravel and small stones which help to drain the slope.

In a few locations, particularly at an elevation approximately 6 feet below the embankment crest, the riprap has shifted toward the reservoir. The movement of the riprap was possibly caused by ice action. Photo 6 of Appendix C illustrates this condition.

c. Appurtenant Structures. The gatehouse located at the southwest corner of the reservoir, contains hoists for 2 sluice gates (the lower one of which does not appear operable), chlorination facilities and a stage recorder. At the time of the inspection, these facilities were not being used. The gatehouse and operating equipment (excluding the lower gate hoist) appeared to be in satisfactory condition on the date of the inspection.

The condition of the equipment located in the gatehouse is generally poor. The low level sluice gate and stage level recorder do not appear to be operable and the valve stems are very corroded. The chlorination facilities will also require some repair prior to putting the reservoir back into service. Inlet screens, in the gatehouse however, appear to be new.

SECTION 2

ENGINEERING DATA

2.1 Design

No design information with respect to the construction of Waban Hill Reservoir Dam is available according to personnel from the Metropolitan District Commission.

2.2 Construction

The only information available with regard to construction of the dam is that it is an earth embankment structure built about 1900.

2.3 Operation

The reservoir is currently out of operation for maintenance operations, but will be put back into use once water quality standards are met.

Outflow from the reservoir may be controlled at the gatehouse by opening or closing sluice gates, as required. A section of the gatehouse is included in Appendix B to illustrate the locations of these gates. (Also see Section 4 of this report.)

2.4 Evaluation

a. Availability. Several drawings of the reservoir and appurtenances are available from the MDC.

b. Adequacy. Sufficient information was obtained during the field investigation, from the plans and details provided, and through subsequent telephone conversations with personnel from the MDC for a Phase I dam evaluation.

It is noted, however, that seepage problems may have gone undetected because of the low water level in the reservoir.

c. Validity. The drawings received from the MDC appear to reflect actual field conditions.

d. Reservoir Length. (Feet)

1.	Normal Pool (Current)	445
2.	Flood Control Pool	NA
3.	Spillway Crest Pool	NA
4.	Top of Dam	490
5.	Test Flood Pool	490

e. Storage. (Acre-Feet)

1.	Normal Pool (Current)	8
2.	Flood Control Pool	NA
3.	Spillway Crest Pool	NA
4.	Top of Dam	58
5.	Test Flood Pool	58

f. Reservoir Surface. (Acres)

1.	Normal Pool (Current)	1.9
2.	Flood Control Pool	NA
3.	Spillway Crest Pool	NA
4.	Top of Dam	2.9
5.	Test Flood Pool	2.9

g. Dam.

1.	Type	Earth Embankment
2.	Length	1,100 feet
3.	Height	28 feet
4.	Top Width	17 feet
5.	Side Slopes	Interior 1H:1V Exterior 1.5H:1V
6.	Zoning	Unknown
7.	Impervious Core	Unknown
8.	Cutoff	Unknown
9.	Grout Curtain	Unknown

h. Diversion and Regulating Tunnel. None

i. Spillway. None

j. Regulating Outlets

1.	Water Supply	
a)	Invert	237.6+
b)	Size	20-inch
c)	Description	Water Supply Pipe
d)	Control Mechanism	Two Sluice Gates
2.	Reservoir Drain	
a)	Invert	Unknown
b)	Size	8-inch
c)	Description	Reservoir Drain Pipe
d)	Control Mechanism	8-inch valve

i Normal Operating Procedures. At present there are no operating procedures since the reservoir is out of service.

1.3 Pertinent Data

a. Drainage Area. The area draining to Waban Hill Reservoir is restricted to that area bounded by the reservoir embankment. The surface area of the impoundment at maximum storage is approximately three acres.

b. Discharge at Damsite

1. Outlet Works. There are two outlets from the reservoir. The primary outlet is located at the southwest corner and consists of a 20-inch cast iron pipe connecting to a 36-inch water main on Ward Street. The other outlet is an 8-inch diameter cast iron drain which may be used to lower the impoundment.

2. Maximum Known Flood. According to the Owner, the maximum allowable water elevation is 260.2. It is not known if the actual water elevation has ever approached crest elevation.

3. Ungated Spillway Capacity at Top of Dam. Not applicable.

4. Ungated Spillway Capacity at Test Flood Elevation. Not applicable.

5. Gated Spillway Capacity at Normal Pool Elevation. Not applicable.

6. Gated Spillway Capacity at Test Flood Elevation. Not applicable.

7. Total Spillway Capacity at Test Flood Elevation. Not applicable.

8. Total Project Discharge at Top of Dam. The discharge through the 8-inch diameter drain, operating under a static head of approximately 20 feet, is estimated to be 3 cfs. This discharge condition corresponds to the maximum allowable water surface elevation of 260.2 and does not include discharge to the City of Boston water distribution system.

9. Total Project Discharge at Test Flood Elevation. Refer to item 8, above.

c. Elevation (NGVD)

1. Streambed at Toe of Dam	NA
2. Bottom of Cutoff	Unknown
3. Maximum Tailwater	NA
4. Normal Pool (Current)	240.2
5. Full Flood Control Pool	NA
6. Spillway Crest (Gated)	NA
7. Design Surge (Original Design)	Unknown
8. Top of Dam	262.2
9. Test Flood Design Surge	262.2

80 percent of the impounding structure. The embankment is approximately 1,100 feet long with a maximum height of about 28 feet and has the following features:

1. The interior face of the embankment has a slope of 1H:IV and is protected by hand-placed stone riprap.
2. The crest is approximately 17 feet wide for the entire length of the embankment.
3. The exterior face of the embankment is on a slope of about 1.5H:IV and varies in length from zero at the abutments to a maximum of 48 feet at the southeast corner of the reservoir.

The inlet to the reservoir is located at the bottom of the reservoir near the northeast corner. Opposite the inlet, in the southwest corner, is a gatehouse which provides access to a pair of sluice gates and housing for the chlorination facilities.

At the time of inspection, the reservoir was not in service.

c. Size Classification. Waban Hill Reservoir has a maximum embankment height of about 28 feet which places it in the "Small" size category for height because it is less than 40 feet high. It also falls into the "Small" size category for storage since its maximum storage capacity is 58 acre-feet which is less than the 1,000 acre-foot upper limit for "Small" size dams. Therefore, Waban Hill Reservoir is classified as "Small" for the purposes of this inspection program.

d. Hazard Classification. There are two possible direction in which water from the reservoir could flow, depending upon the location of the dam breach. In either case, within a few hundred feet north or south of the reservoir, the damage center is an urban residential neighborhood. Excessive property damage and loss of life could be expected if the reservoir embankment ever failed when the reservoir is near capacity. Therefore, the hazard classification for Waban Hill Reservoir is "High".

e. Ownership. The dam is owned by the Metropolitan District Commission (MDC), 20 Somerset Street, Boston, Massachusetts, 02109; Telephone 617-727-5275.

f. Operator. At the time of the inspection, the reservoir was out of service; consequently, no operator was employed at the site. According to the MDC representative, an operator is on duty whenever the reservoir is in service.

g. Purpose of Dam. The reservoir was constructed to impound water for use in the water supply system for the City of Boston and surrounding communities. It is currently out of service for maintenance operations, but according to Mr. William Thompson of the MDC Distribution Section, the reservoir will be put back into service once water quality standards are met.

h. Design and Construction History. The reservoir was constructed about 1900, but according to the Owner's representative, no design and construction data with respect to the embankment have been located. The only information available consists of the site plans and a sectional drawing of the gatehouse included in Appendix B.

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
WABAN HILL RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The National Dam Inspection Act of August 8, 1972 (Public Law 92-367), authorized the Secretary of the Army, through the Corps of Engineers, to initiate the National Program for Inspection of Dams throughout the United States. Responsibility for supervising inspection of dams in the New England Region has been assigned to the New England Division of the Corps of Engineers.

O'Brien & Gere Engineers, Inc. has been retained by the New England Division to inspect and report on selected non-federal dams in the Commonwealth of Massachusetts. Authorization and Notice to Proceed were issued to O'Brien & Gere by a letter dated November 6, 1979 and signed by Colonel William E. Hodgson, Jr. Contract No. DACW33-80-C-0014 has been assigned by the Corps of Engineers for this work.

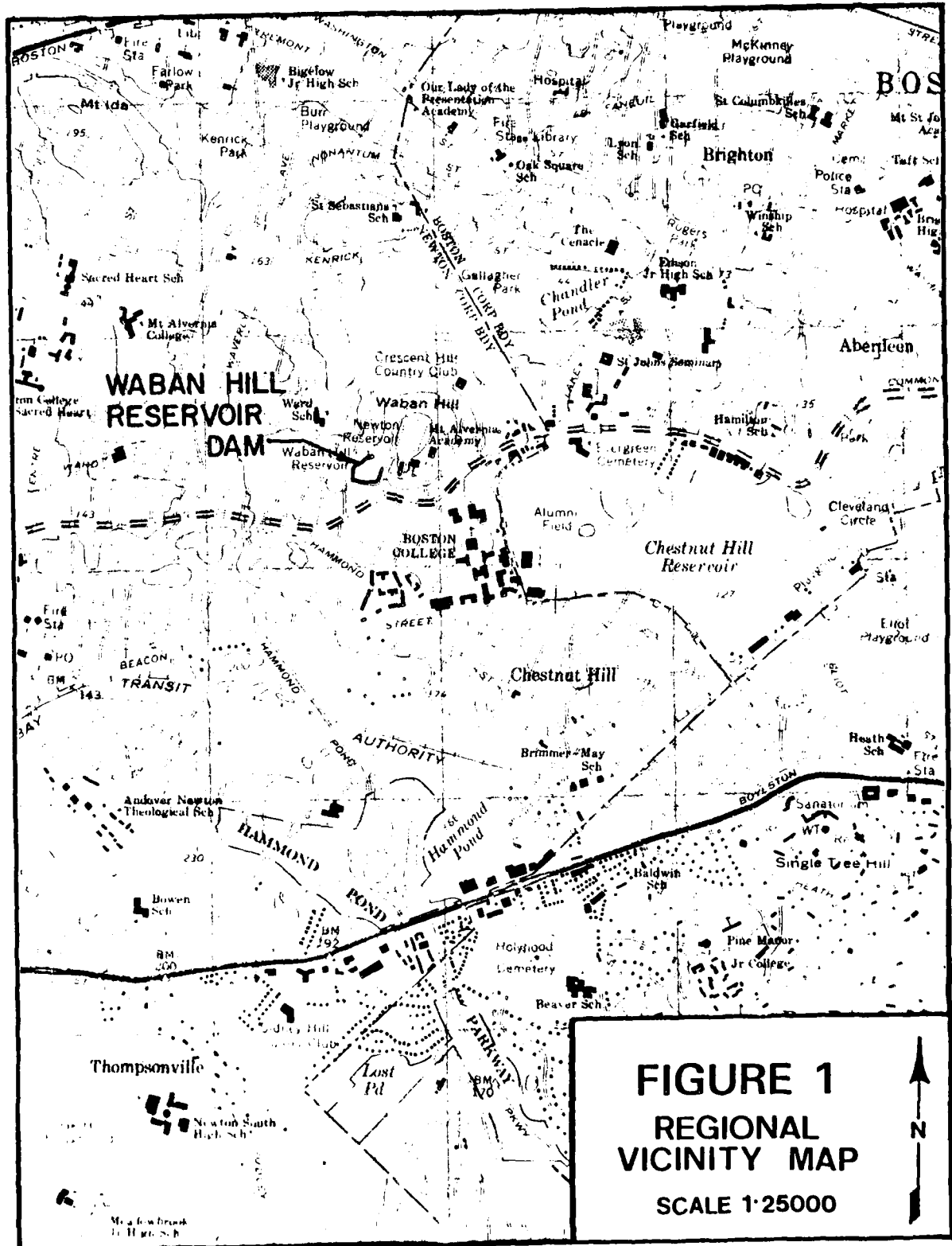
b. Purpose of Inspection. The purpose of inspecting and evaluating non-federal dams is to:

1. Identify conditions which threaten public safety and make the Owner aware of any deficiencies so that he may correct them in a timely manner.
2. Encourage and prepare the states to initiate effective dam safety programs for non-federal dams as soon as possible.
3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project. (Information for this dam was obtained from the Metropolitan District Commission (MDC)).

a. Location. Waban Hill reservoir is located in the Town of Newton, Massachusetts. A portion of the USGS Quadrangle map entitled "Newton, Massachusetts" has been included as Figure 1 on page vi of this report to illustrate the location. USGS reference coordinates for this site are N 42°20.2' and W 71°10.6'. The potential damage centers, urban residential neighborhoods, are within a few hundred feet to the north and south of the reservoir.

b. Description of Dam and Appurtenances. Waban Hill Reservoir is not located on a stream and is only filled by direct rainfall. The reservoir is confined in part by an earth embankment which forms approximately



APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST
INSPECTION TEAM ORGANIZATION

Project: Waban Hill Reservoir
National I.D. #: MA 01111
Location: Newton, Massachusetts
Type of Dam: Earth Embankment
Inspection Date(s): October 23, 1979
Weather: Overcast, low 60's
Pool Elevation: 247.5 MSL

Inspection Team

Leonard Beck	O'Brien & Gere	Structures
Steven Snider	O'Brien & Gere	Foundations & Materials
Alan Hanscom	O'Brien & Gere	Structures
Rodney Georges	Bryant & Associates	Hydrology/Hydraulics

*Mr. John J. Williams, Vice-President, O'Brien & Gere has visited the site but not necessarily in conjunction with the inspection team.

Owner's Representative

Mr. William R. Thompson, Superintendent, Water Division, Metropolitan

District Commission.

VISUAL INSPECTION CHECK LIST

Project: Waban Hill Reservoir

National I.D. #: MA 01111

Date(s): October 23, 1979

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT</u>	
Crest Elevation	262.2 MSL
Current Pool Elevation	247.5 MSL
Maximum Impoundment to Date	50+ Acre-ft.
Surface Cracks	None Observed
Pavement Condition	N/A
Movement or Settlement of Crest	None Observed
Lateral Movement	None Observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Slight Erosion @ Gatehouse
Indications of Movements of Structural Items on Slopes	None Observed
Trespassing on Slopes	Insignificant
Vegetation on Slopes	Some bushes, small trees
Sloughing or Erosion of Slopes or Abutments	Slight @ Gatehouse
Rock Slope Protection - Riprap Failures	Several rip-rap failures Extensive repairs required

VISUAL INSPECTION CHECK LIST

Project: Waban Hill Reservoir

National I.D. #: MA 01111

Date(s): October 23, 1979

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT (Con't)</u>	
Unusual Movement or Cracking at or near Toes	None Observed
Unusual Embankment or Downstream Seepage	None*
Piping or Boils	None
Foundation Drainage Features	Unknown
Toe Drains	Unknown
Instrumentation System	N/A
<p>*Note that pool elevation was only a few feet above toe of dam at time of inspection.</p>	

VISUAL INSPECTION CHECK LIST

Project: Waban Hill Reservoir
 National I.D. #: MA 01111
 Date(s): October 23, 1979

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Concrete	Good
Rust or Staining	Insignificant
Spalling	Slight
Erosion or Cavitation	None Observed
Visible Reinforcing	None
Any Seepage or Efflorescence	None Observed
Condition at Joints	Good
Drain Holes	None Observed
Channel	20-inch outlet pipe
Loose Rock or Trees Overhanging Channel	None
Condition of Discharge Channel	Unknown

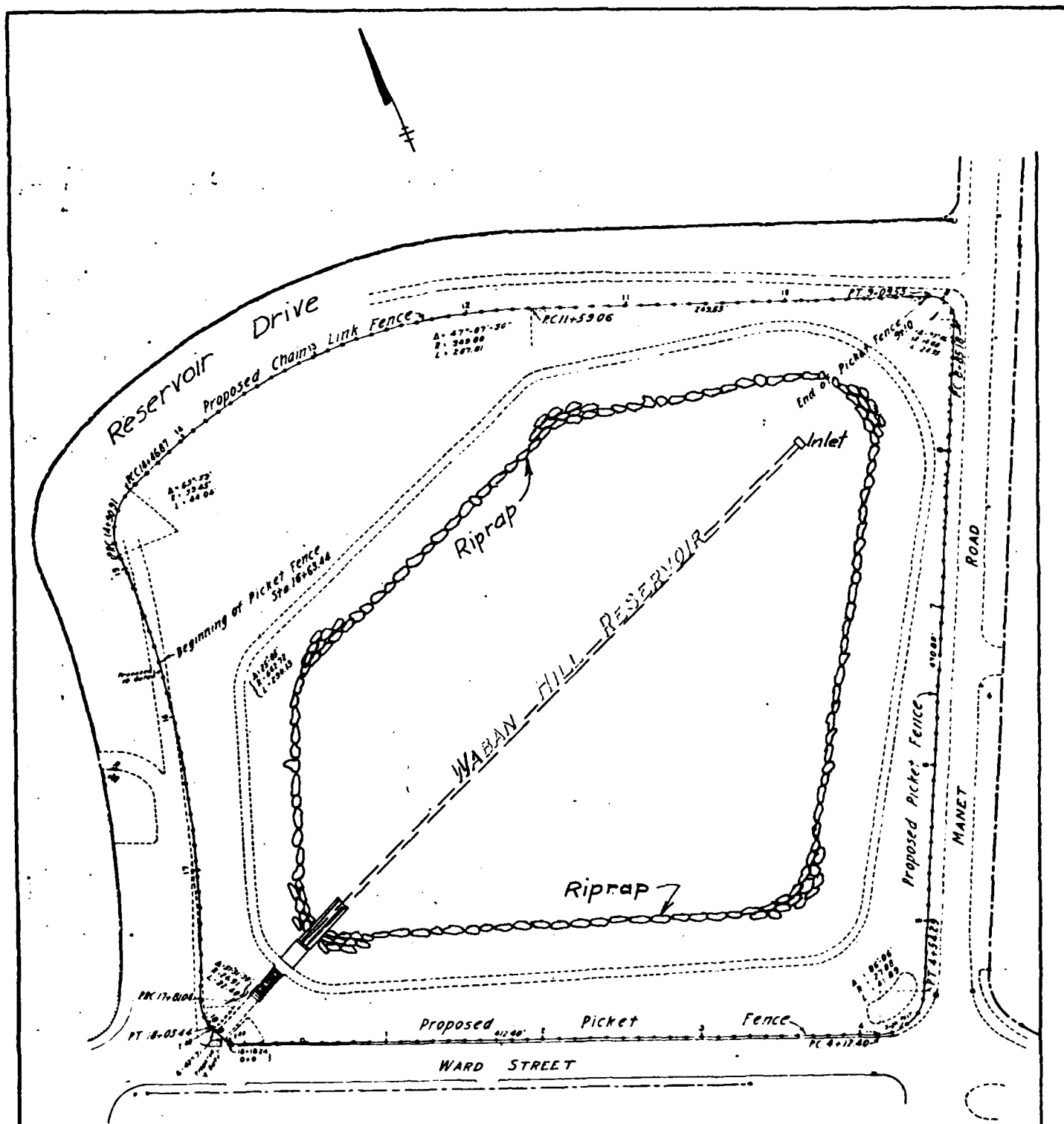
APPENDIX B

ENGINEERING DATA

SUBJECT	WABAN HILL RESERVOIR DAM	SHEET	BY	DATE	JOB NO
---------	--------------------------	-------	----	------	--------

APPENDIX B
ENGINEERING DATA
TABLE OF CONTENTS

	<u>PAGE</u>
SITE PLAN, 1930	B-1
PROPOSED DRAIN, 1901	B-2
1 1/2" AIR VALVE, 36" VALVE, 36" SPECIALS AND GATEHOUSE	B-3
36"x 30" BRANCH AND 1/32 CURVES	B-4
SECTION THROUGH GATEHOUSE	B-5



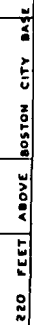
Site Plan

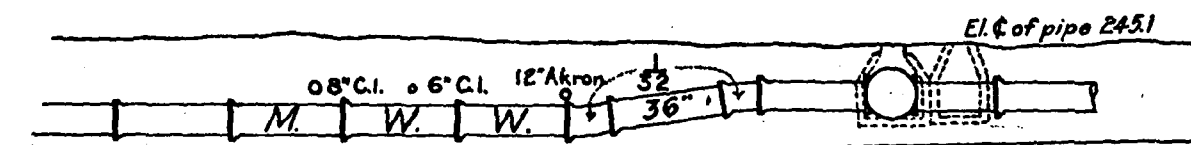
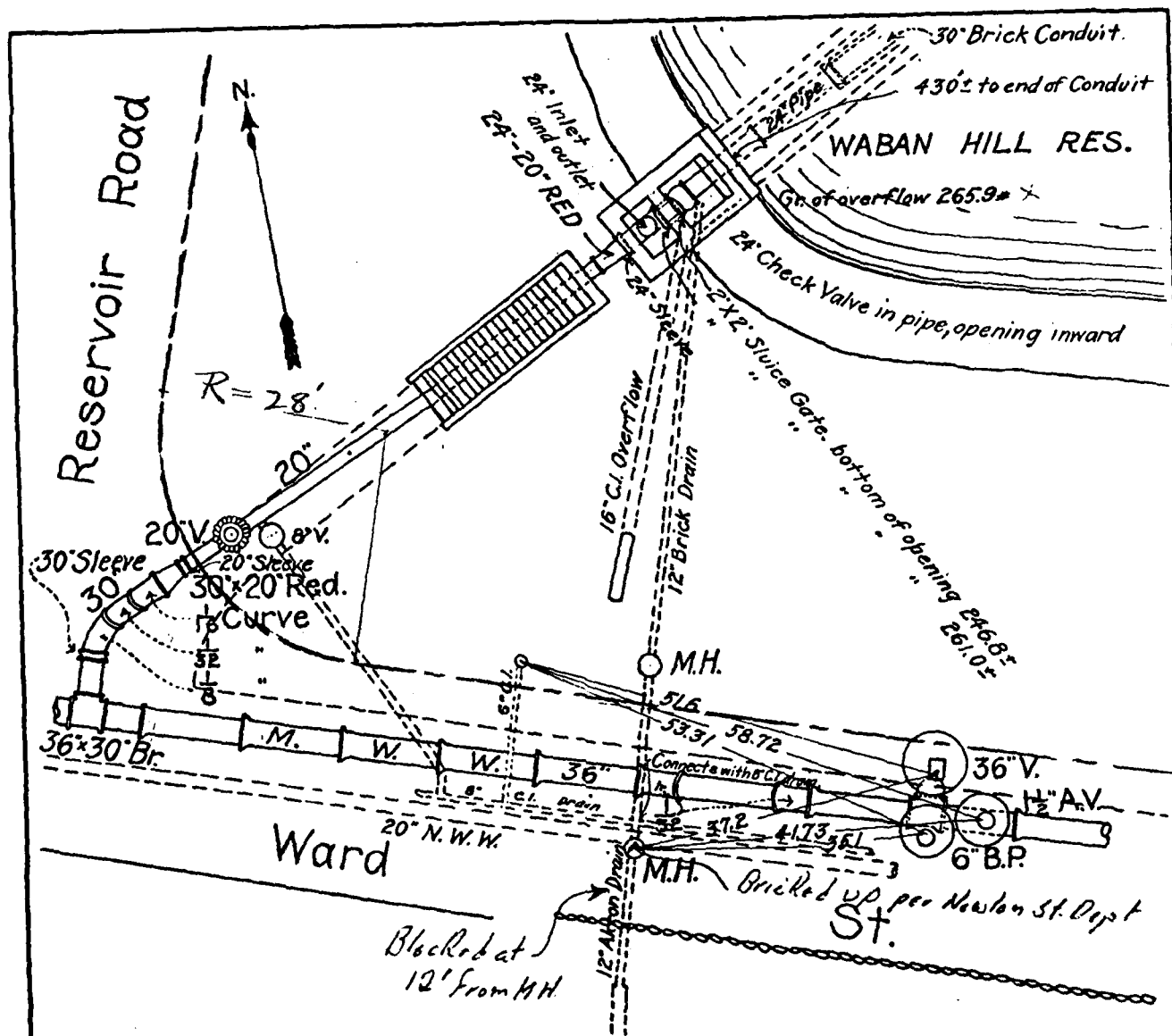
Hor. Scale. 40 ft to an in.
Ver. " 4 " " "

Sept. 18, 1901.

Hor. Scale. 40 ft to an in.
Ver. " 4 " " "

Sept. 18, 1901.

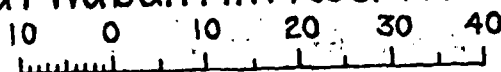




240 FT. ABOVE BOSTON CITY BASE

Profile

1 1/2" Air Valve, 36" Valve and 36" Specials
Also Gate Ho. at Waban Hill Res. - Ward St. - Newton.



SCALE OF FEET

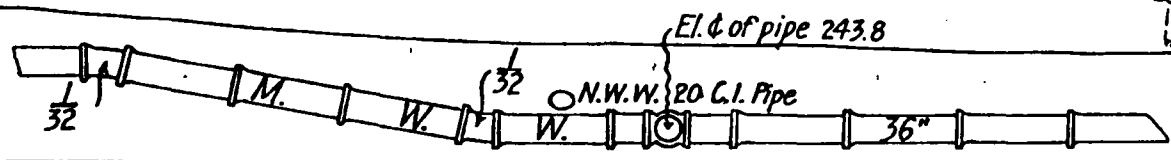
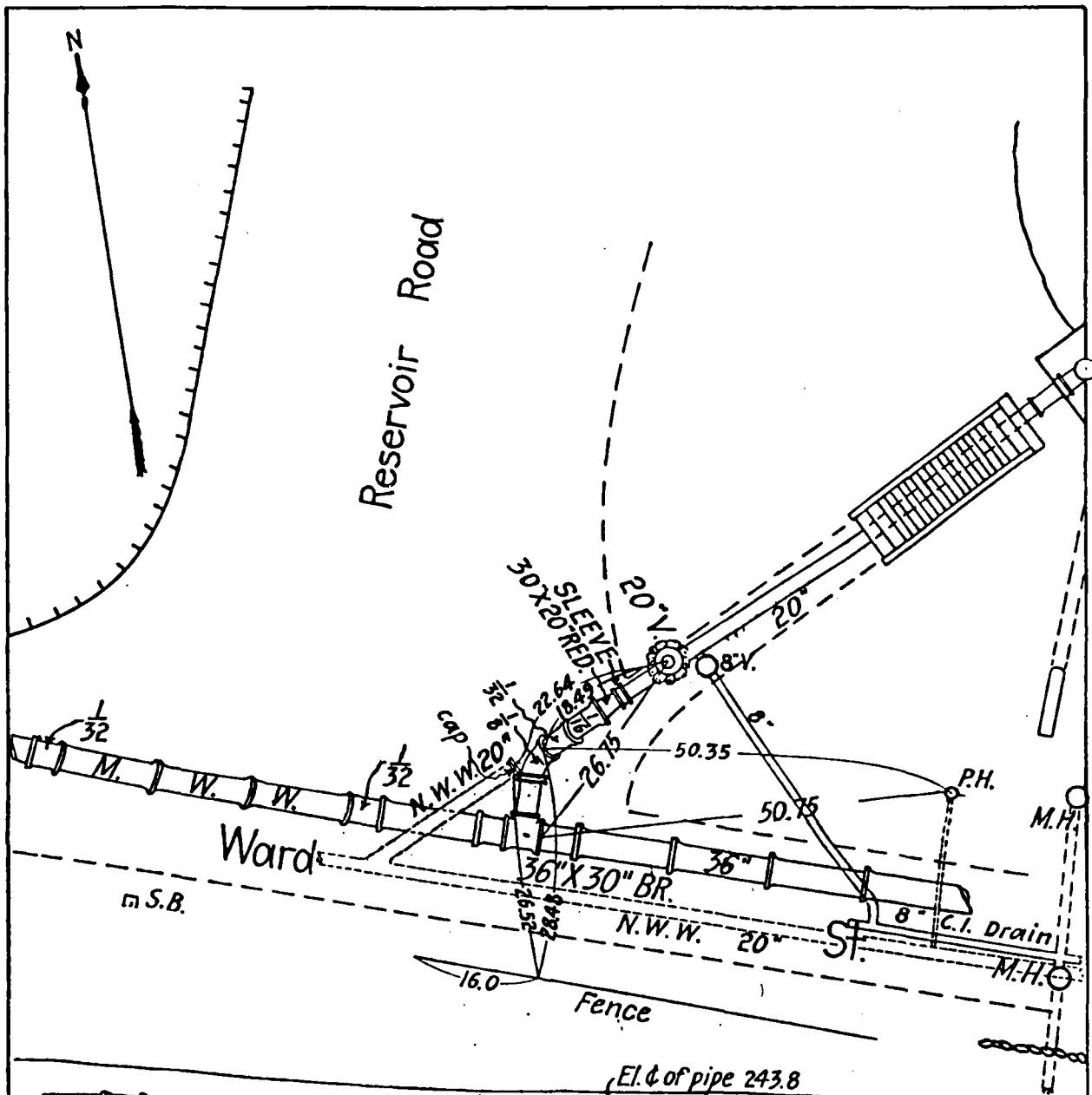
Jan. 1901.

Corrected Feb. 1913

From Chestnut Hill Res. Sta. 79+18 A.V.

B-3

Detail Record 23-9



240 FT. ABOVE BOSTON CITY BASE

Profile

36"X30" Branch and $\frac{1}{32}$ Curves
Also connection with Waban Hill Res. Ward St.-Newton.



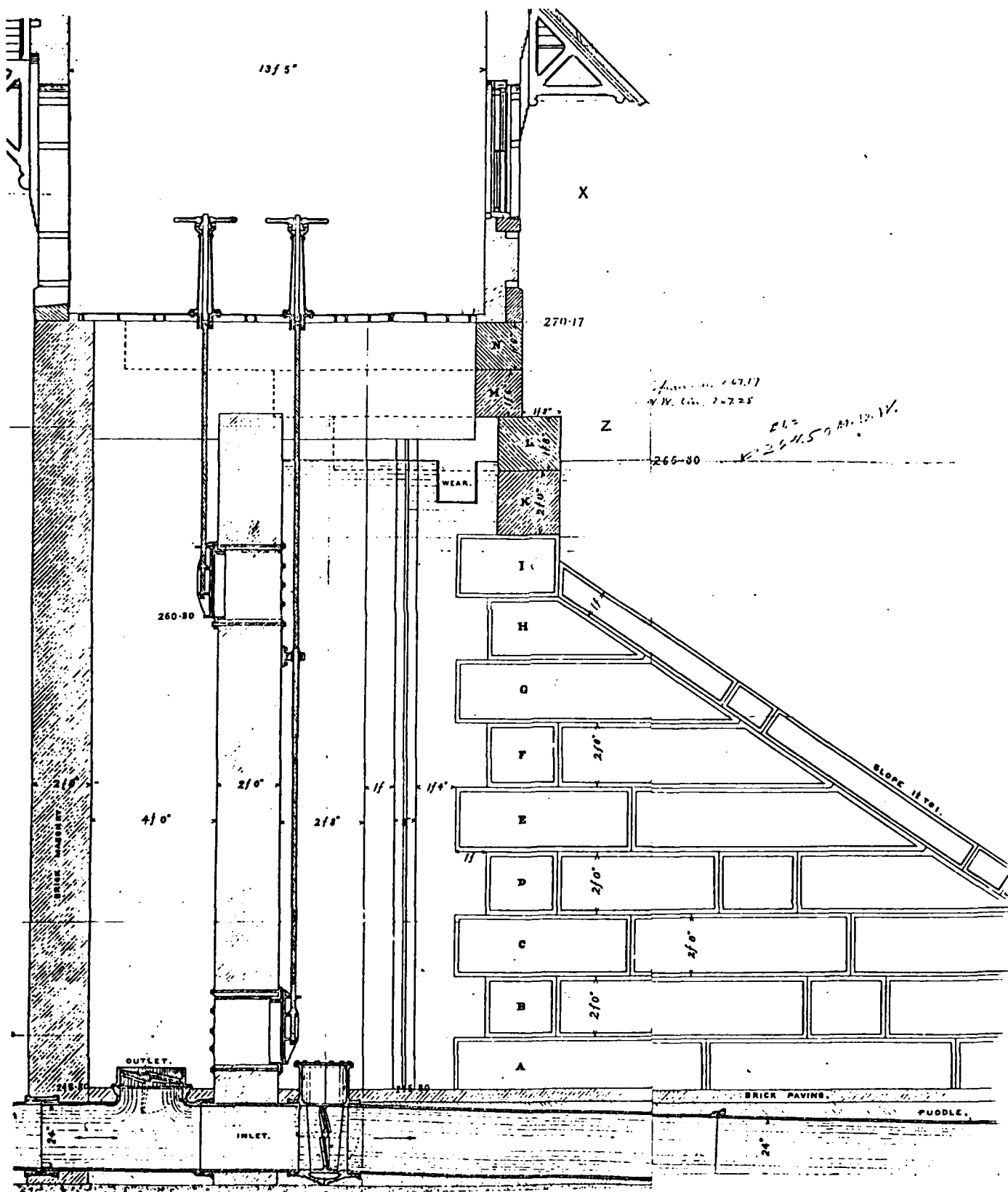
SCALE OF FEET

Jan. 1901.

B-4

From Chestnut Hill Res. Sta. 80+26 BR.

Detail Record 23-10



Section Through Gatehouse

B-5

APPENDIX C

PHOTOGRAPHS

APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT

<u>LOCATION PLAN</u>	<u>Page</u> <u>No.</u>
Site Plan Sketch	A

PHOTOGRAPHS

<u>No.</u>		<u>Page</u> <u>No.</u>
1.	Northeast corner of reservoir cut into hillside slope showing vegetative growth on the inside slope.	1
2.	Embankment crest looking south towards hazard area.	1
3.	Embankment crest and inside slope looking towards gatehouse on the south side of the reservoir.	2
4.	Gatehouse and inside slope at the southwest corner of the reservoir.	2
5.	Concrete retaining wall, gatehouse and outside slope at the southwest corner of the reservoir.	3
6.	Typical condition of displaced riprap and cavity on the inside slope.	3
7.	Intake and trash screen on the gatehouse at the southwest corner of the reservoir.	4
8.	Gate hoists inside the gatehouse.	5
9.	Potential hazard area along the east side of the reservoir.	6
10.	Potential hazard area at the southeast corner of the reservoir.	6
11.	Potential hazard area along the south side of the reservoir.	7
12.	Potential hazard area along the west side of the reservoir.	7

HYDROLOGIC ANALYSIS OF WABAN HILL RESERVOIR DAM NATIONAL DAM SAFETY PROGRAM NEW ENGLAND DIVISION - CORPS OF ENGINEERS

NO NHR NMN IDAY IHR IMIN METRC IPLT IPRT NSTAN
200 0 15 0 0 0 0 0 -4 0
JUPEH NWT LROPT TRACE
5 0 0 0

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLANE 1 NHTIO= 1 LRTIO= 1

NO INFLOW → RTIOS= .00

HYDROGRAPH ROUTING

BREACH ROUTING WABAN HILL RES. DAM

ISTAU ICUMP IECON ITAPE JPLT JPRT INAME ISTAGE IAUTO
WABAN 1 0 0 0 0 0 0 0 0
ROUTING DATA
QLOSS CLUSS AVG IRES ISAME IOPT IPMP LSTR
0.0 0.000 0.00 1 1 0 0 0
NSTPS NSTDL LAG AMSKK X TSK STORA ISPRAT
1 0 0 0.000 0.000 0.000 -262. -1

STAGE - DISCHARGE DATA

STAGE 262.20 264.20 270.00 }
FLOW 0.00 9607.00 73988.00

SURFACE AREA= 2. 2. 3.
CAPACITY= 0. 26. 58.
ELEVATION= 238. 250. 262.

CREL SPWID 0.0 0.0 0.0
262.2 0.0 0.0 0.0 0.0 0.0 0.0

DAM DATA

TOPEL COUD EXPD DAMWID
262.2 0.0 0.0 0.0

HRWID Z DAM BREACH DATA
FLHM TFAIL WSEL FAILFL

BREACH DIMENSIONS -
FAILURE BEGINS IMMEDIATELY
WITH RESERVOIR SURFACE
AT TOP OF DAM

200. .01 260.00 1.00 262.20 262.20

BEGIN DAM FAILURE AT 0.00 HOURS

PEAK OUTFLOW IS 746. AT TIME .19 HOURS

FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

WARREN HILL RESERVOIR DAM BREACH OUTFLOW ROUTING
 TO NORTHERN DAMAGE AREA

INPUT

HYDROLOGIC ANALYSIS OF WARREN HILL RESERVOIR DAM - NORTHERN DAMAGE CENTER

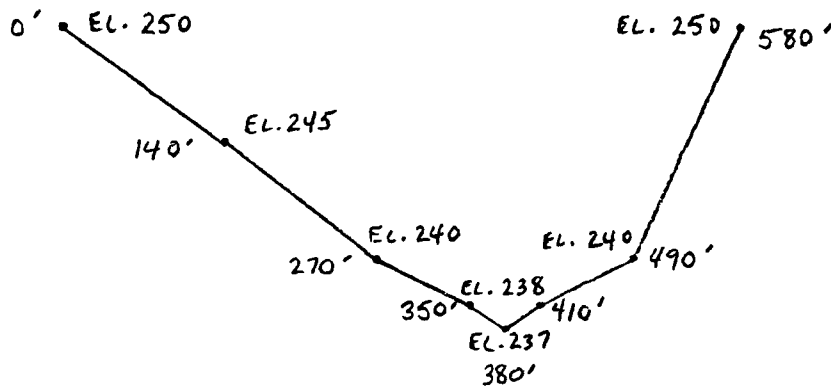
NATIONAL DAM SAFETY PROGRAM
 NEW ENGLAND DIVISION - CORPS OF ENGINEERS

1	A1	0	15	0	0	0	0	-4	0
2	A2	0	0	0	0	0	0	0	0
3	A3	0	0	0	0	0	0	0	0
4	B	200	0	0	0	0	0	0	0
5	B1	5	0	0	0	0	0	0	0
6	J	1	1	1	1	1	1	1	1
7	J1	0.001	0	0	0	0	0	0	0
8	K	1	0	0	0	0	0	0	0
9	K1	1	0	0	0	0	0	0	0
10	Y	0	0	0	0	0	0	0	0
11	Y1	1	0	0	0	0	0	0	0
12	Y4	262.2	264.2	270	270	270	270	270	270
13	Y5	0	9607	73968	73968	73968	73968	73968	73968
14	SA	1.9	2.4	2.9	2.9	2.9	2.9	2.9	2.9
15	SE	238	250	262.2	262.2	262.2	262.2	262.2	262.2
16	SS	262.2	262.2	262.2	262.2	262.2	262.2	262.2	262.2
17	SD	262.2	262.2	262.2	262.2	262.2	262.2	262.2	262.2
18	SB	200	0.01	240	1.0	262.2	262.2	262.2	262.2
19	K	1	0.01	240	1.0	262.2	262.2	262.2	262.2
20	K1	1	0.01	240	1.0	262.2	262.2	262.2	262.2
21	Y	1	0.01	240	1.0	262.2	262.2	262.2	262.2
22	Y1	1	0.01	240	1.0	262.2	262.2	262.2	262.2
23	Y6	.1	.1	.1	.1	.1	.1	.1	.1
24	Y7	0	250	140	245	270	240	240	237
25	Y7	410	238	490	240	580	250	250	237
26	K	99	0	0	0	0	0	0	0

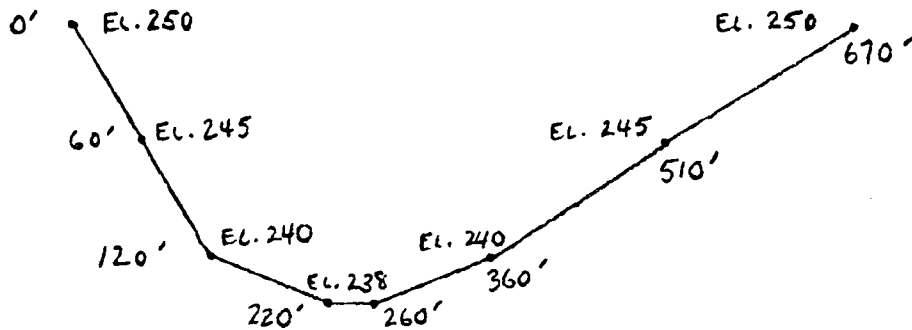
ECT	SHEET	BY	DATE	JOB NO
ABAN HILL RESERVOIR DAM - CHANNEL CROSS-SECTIONS	D-3	RRB		

FLOW AREA CROSS-SECTIONS (FOR HEC-1 PROGRAM)

NORTH



SOUTH



PROJECT	SHEET	BY	DATE	JOB NO.
WABAN HILL RESERVOIR DAM	D-2	RRB		

HYDROLOGY & HYDRAULICS

WABAN HILL RESERVOIR IS NOT LOCATED ON A STREAM AND MAY ONLY BE FILLED BY DIRECT RAINFALL. IN ADDITION, THERE IS NO SPILLWAY PROVIDED FOR THIS STRUCTURE. THE TEST FLOOD IS CONSIDERED TO BE THE PMP. THE PMP WAS CALCULATED AS FOLLOWS:

FROM HMS # 33, THE 24-HOUR, 200-SQUARE MILE INDEX RAINFALL
= 21.5 INCHES

FOR A DRAINAGE AREA ≤ 10 SQUARE MILES, THE 24-HOUR RAINFALL
= $1.33 (21.5) = \underline{28.6 \text{ INCHES}}$

APPLYING THE HOP BROOK ADJUSTMENT FACTOR, WHICH ACCOUNTS FOR THE IMPROPER FIT OF STORM ISOHYETALS OVER THE DRAINAGE BASIN:

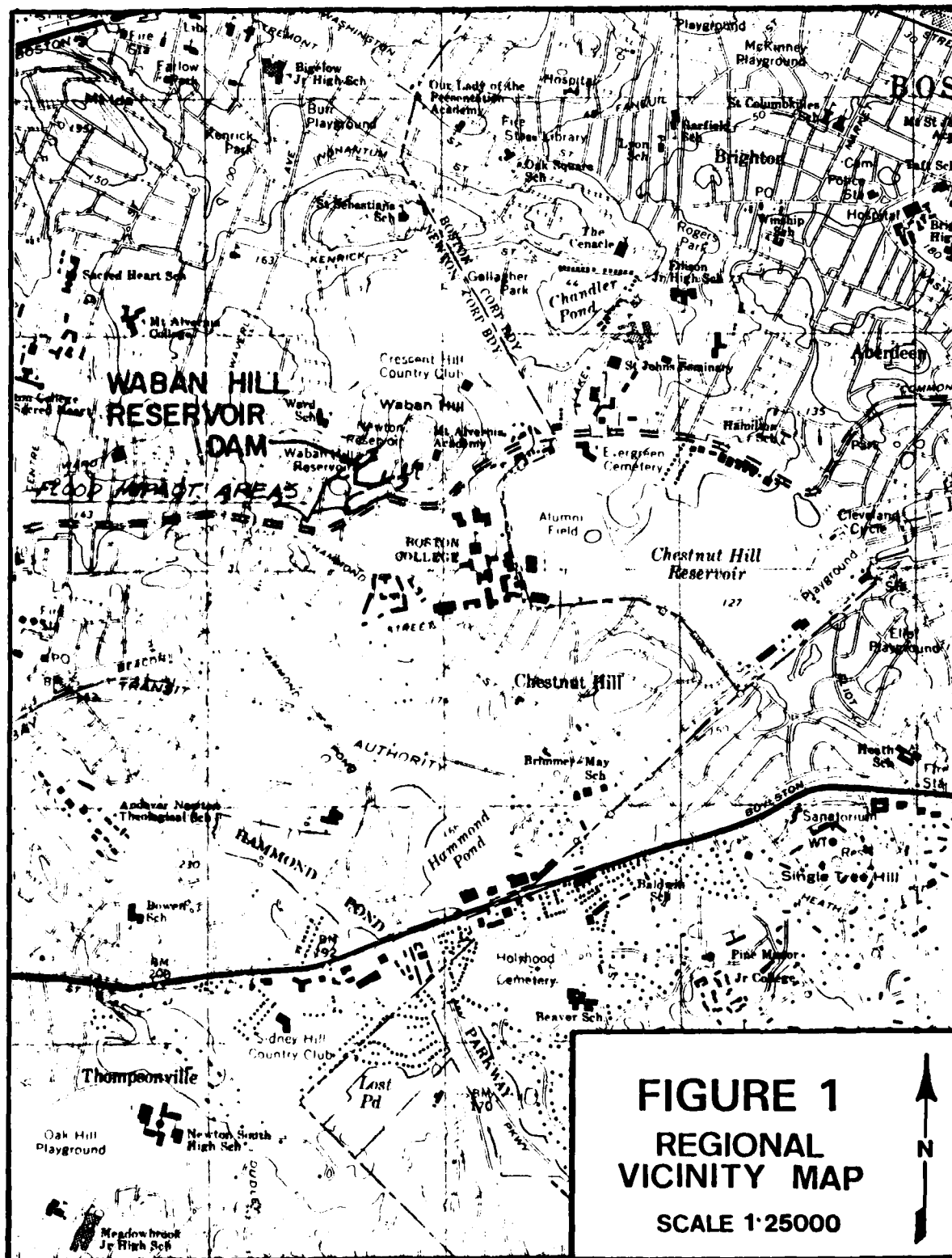
$$\text{THE PMP} = 28.6 (0.8) = \boxed{22.9 \text{ INCHES}}$$

APPLYING THE PMP DIRECTLY TO THE NORMAL POOL RESERVOIR SURFACE YIELDS A TEST FLOOD ELEVATION OF $260.2 + 1.9 = 262.1$

THE TOP OF THE DAM IS AT ELEVATION 262.2 AND, THEREFORE, IT IS UNLIKELY THAT THE EMBANKMENT WOULD EVER BE OVERTOPPED.

STAGE-STORAGE

<u>ELEVATION</u>	<u>AREA (ACRES)</u>	<u>STORAGE (ACRE-Feet)</u>
238	1.9	0
250	2.4	26
262.2	2.9	58



APPENDIX D
HYDROLOGIC & HYDRAULIC COMPUTATIONS
TABLE OF CONTENTS

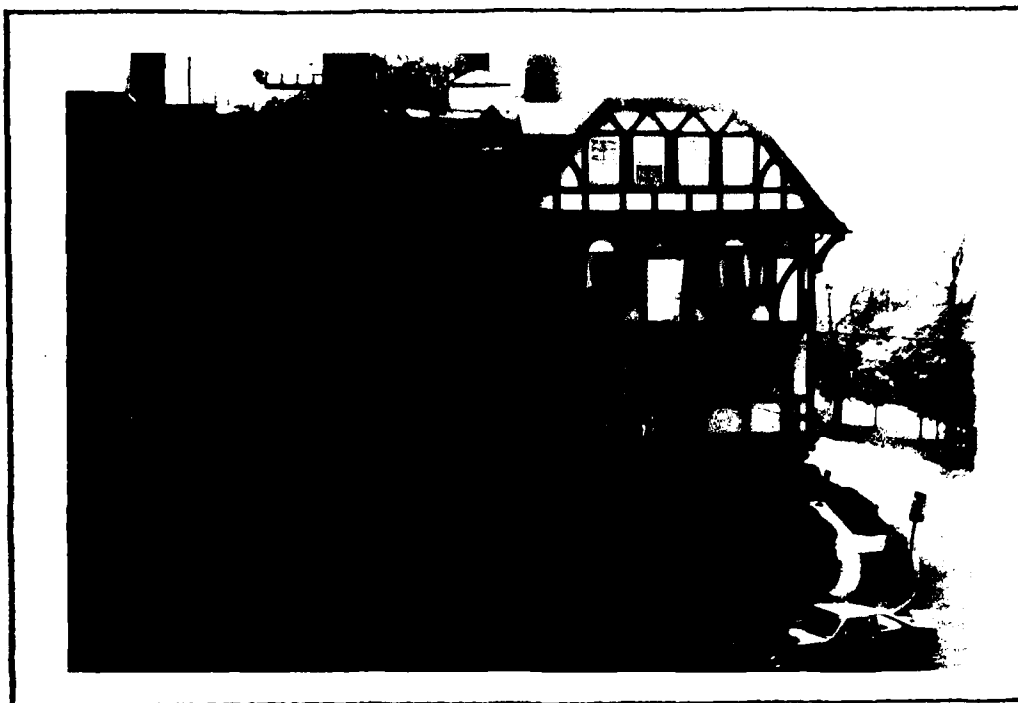
	<u>PAGE</u>
REGIONAL VICINITY MAP, FIGURE 1-SHOWING FLOOD IMPACT AREAS	D-1
PMP DATA, STAGE-STORAGE VALVES	D-2
FLOOD DAMAGE AREA CROSS-SECTIONS	D-3
HEC-1 DAM SAFETY VERSION, COMPUTER OUTPUT	D-4 to D-7
HEC-1 DAM SAFETY VERSION, BREACH ANALYSIS, COMPUTER OUTPUT	D-8 to D-11



11. POTENTIAL HAZARD AREA ALONG THE SOUTH SIDE OF THE RESERVOIR.
(10/23/79)



12. POTENTIAL HAZARD AREA ALONG THE WEST SIDE OF THE RESERVOIR.
(10/23/79)



9. POTENTIAL HAZARD AREA ALONG THE EAST SIDE OF THE RESERVOIR.
(10/23/79)



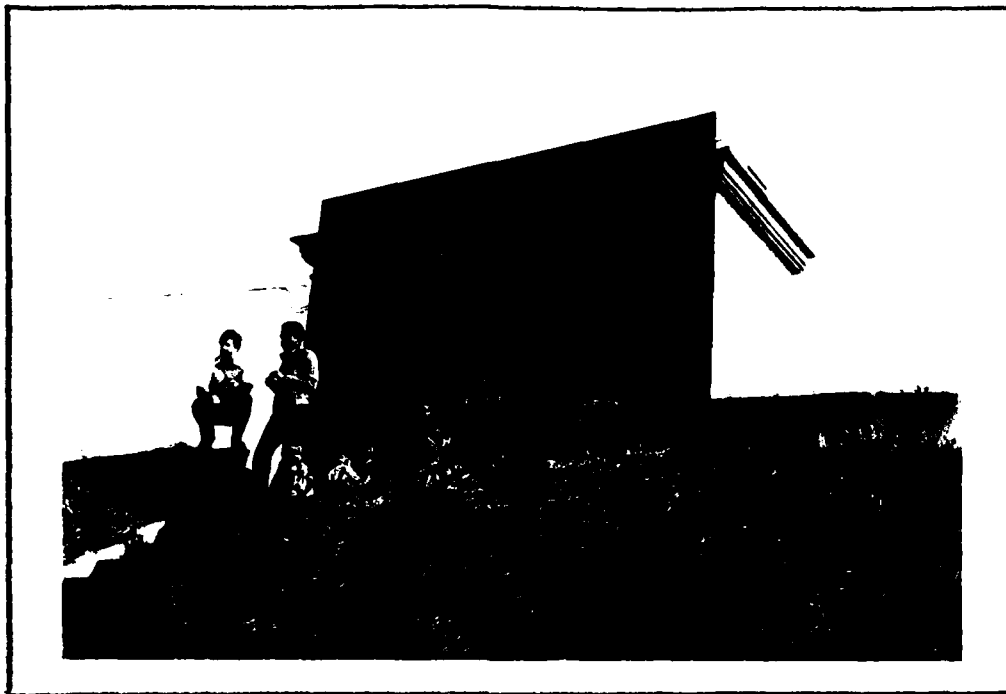
10. POTENTIAL HAZARD AREA AT THE SOUTHEAST CORNER OF THE RESERVOIR.
(10/23/79)



8. GATE HOISTS INSIDE THE GATEHOUSE. (10/23/79)



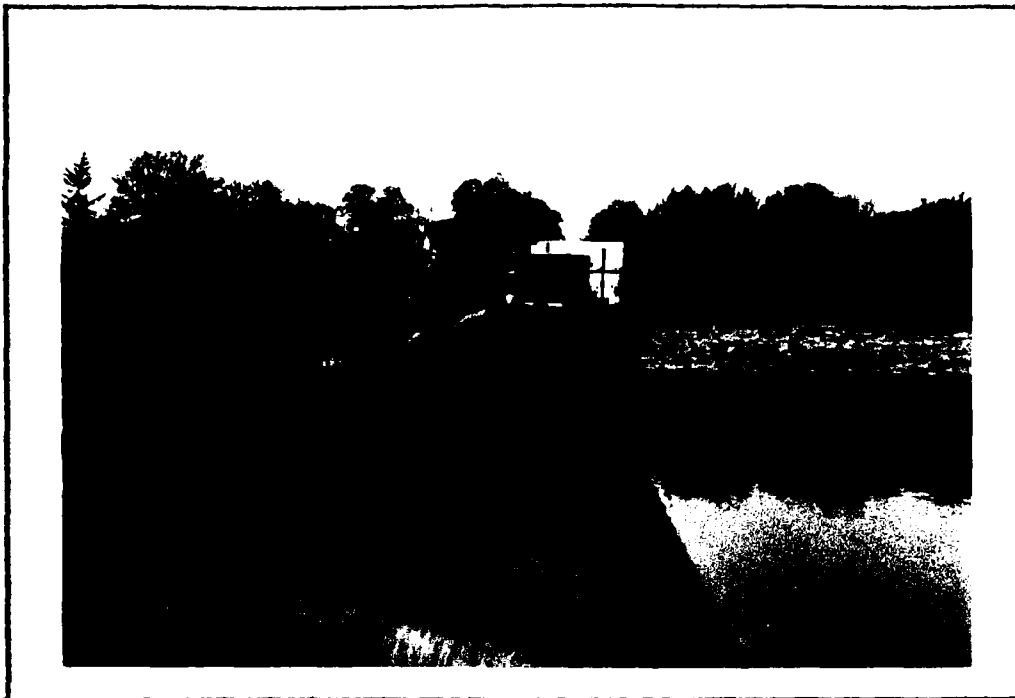
7. INTAKE AND TRASH SCREEN ON THE GATEHOUSE AT
THE SOUTHWEST CORNER OF THE RESERVOIR .
(10/23/79)



5. CONCRETE RETAINING WALL, GATEHOUSE AND OUTSIDE SLOPE AT THE SOUTHWEST CORNER OF THE RESERVOIR. (10/23/79)



6. TYPICAL CONDITION OF DISPLACED RIPRAP AND CAVITY ON THE INSIDE SLOPE. (10/23/79)



3. EMBANKMENT CREST AND INSIDE SLOPE LOOKING TOWARDS GATEHOUSE ON THE SOUTH SIDE OF THE RESERVOIR. (10/23/79)



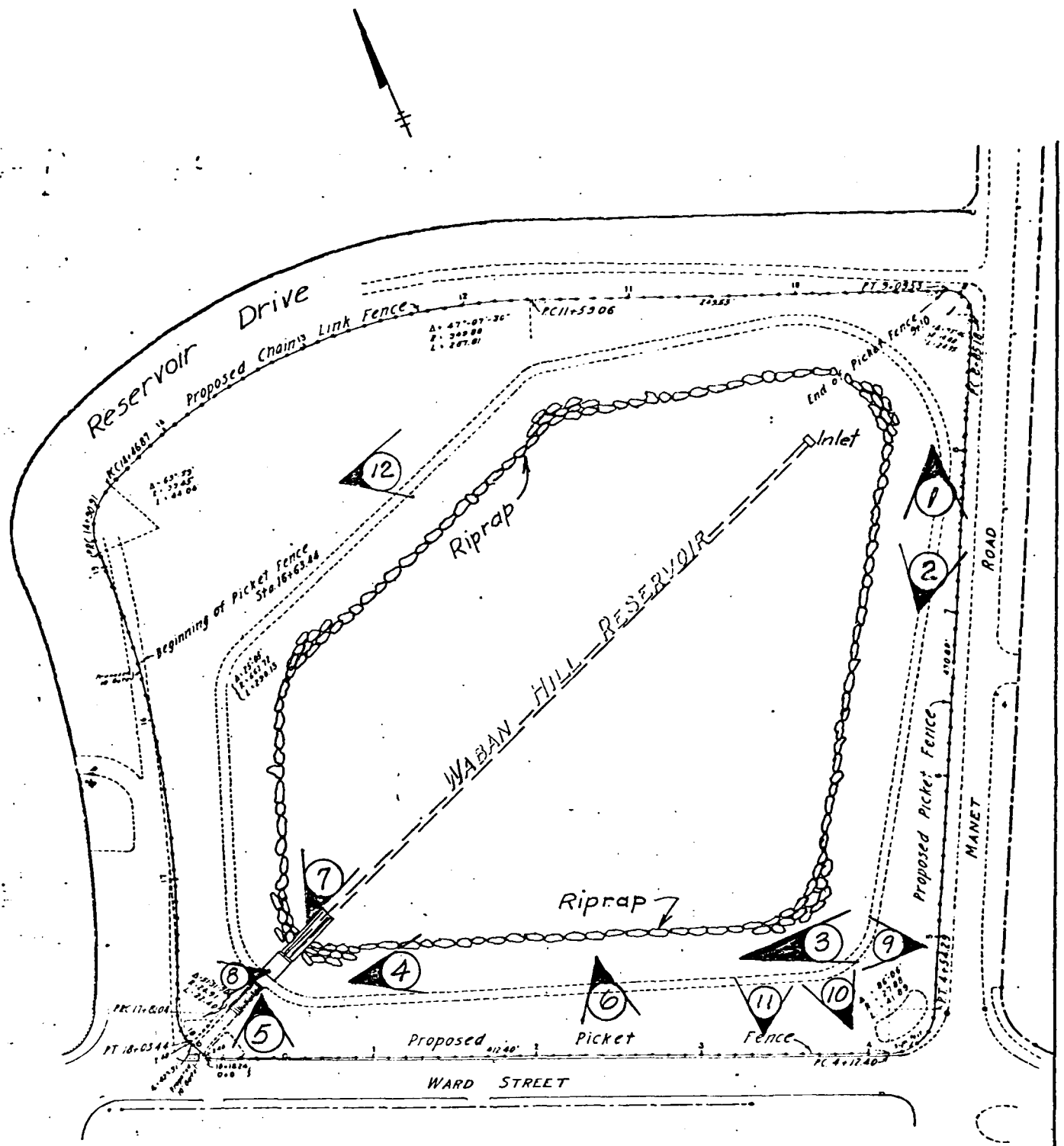
4. GATEHOUSE AND INSIDE SLOPE AT THE SOUTHWEST CORNER OF THE RESERVOIR. (10/23/79)



1. NORTHEAST CORNER OF RESERVOIR CUT INTO HILLSIDE SLOPE SHOWING VEGETATIVE GROWTH ON THE INSIDE SLOPE. (10/23/79)



2. EMBANKMENT CREST LOOKING SOUTH TOWARDS HAZARD AREA. (10/23/79)



Site Plan

LEGEND



THE LOCATION AND DIRECTION IN WHICH EACH PHOTO WAS TAKEN AND THE NUMBER OF THE PHOTO

MDC Plan Dated April 1930

A

CHANNEL ROUTING TO HAZARD CENTER NORTH

ROUTING DATA

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[illegible]

STAGE-STORAGE
AND STAGE -

DISCHARGE
DATA FOR THE

NORTHERN
FLOW AREA

MAXIMUM STAGE IS 239.2' WATER ELEVATION AT DAMAGE AREA

• • • • •

SUMMARY OF DAM SAFETY ANALYSIS

WABAN HILL RESERVOIR DAM - BREACH ROUTED NORTH

PLAN 1

ELEVATION	INITIAL VALUE	SPILLWAY CHEST	TOP OF DAM
STORAGE	262.20	262.20	262.20
OUTFLOW	58.	58.	58.
	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.-ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.00	262.15	0.00	58.	746.	0.00	.19	0.00

PLAN 1 STATION DS-N → ROUTED OUTFLOW

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.00	736.	239.2	.25

→ FLOW THROUGH DAMAGE AREA

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

NABAN HILL RESERVOIR DAM BREACH OUTFLOW
 ROUTED TO SOUTHERN DAMAGE AREA

HYDROLOGIC ANALYSIS OF WABAN HILL RESERVOIR DAM - SOUTHERN DAMAGE CENTER
 NATIONAL DAM SAFETY PROGRAM
 NEW ENGLAND DIVISION - CORPS OF ENGINEERS

INPUT

1	A1	0	15	0	0	0	-4	0
2	A2							
3	A3							
4	B	200	0	0	0	0		
5	B1	5						
6	J	1	1					
7	J1	0.001						
8	K	1						
9	K1							
10	Y	0						
11	Y1	1						
12	Y4	262.2	264.2	270				
13	Y5	0	9607	73988				
14	SA	1.9	2.4	2.9				
15	SE	238	250	262.2				
16	SE	262.2						
17	SD	262.2						
18	SR	200	0.01	240	1.0	262.2	262.2	
19	K	1	DS-S					
20	K1							
21	Y	1						
22	Y1	1						
23	Y6	.1	.1	.1	.1	.1	.1	
24	Y7	0	250	60	245	120	240	
25	Y7	360	240	510	245	670	250	
26	K	99						

LAST MODIFICATION 26 FEB 79

RUN DATE 02/07/80
TIME 12.36.22.

HYDROLOGIC ANALYSIS OF WABAN HILL RESERVOIR DAM
NATIONAL DAM SAFETY PROGRAM
NEW ENGLAND DIVISION - CORPS OF ENGINEERS

NO NHR NMIN IDAY IMR IMIN METRC IPLT IPRT NSTAN
200 0 15 0 0 0 0 0 -4 0
JOPEH 5 0 0 0 0 0 0
TRACE

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLANE= 1 NRTIO= 1 LRTIO= 1

NO INFLOW → RTIOS= .00

HYDROGRAPH ROUTING

BREACH ROUTING WABAN HILL RES. DAM

ISTAU ICUMP IECON ITAPE JPLT JPRT INAME ISTAGE IAUTO
WABAN 0 0 0 0 0 0 0 0 0
ROUTING DATA
QLOSS CLOSS AVG IRES ISAME IOPT IPMP LSTR
0.0 0.000 0.00 1 1 0 0 0
NSIPS NSIDL LAG AMSKK X TSK STORA ISPRAT
1 0 0 0.000 0.000 0.000 -262. -1

STAGE 262.20 264.20 270.00 } STAGE - DISCHARGE DATA

FLOW 0.00 9607.00 73988.00

SURFACE AREA 2. 2. 3. }

CAPACITY= 0. 26. 58. } STAGE - STORAGE DATA

ELEVATION= 238. 250. 262. }

CREL SPWID COQW EXPW ELEVEL COQL CAREA EXPL
262.2 0.0 0.0 0.0 0.0 0.0 0.0 0.0

DAM DATA

TOPEL COQD EXPD DAMWID
262.2 0.0 0.0 0.

BRWID Z DAM BREACH DATA WSEL FAILEL
ELBM TFALL

BREACH DIMENSIONS -
FAILURE BEGINS IMMEDIATELY WITH
RESERVOIR SURFACE AT TOP OF DAM

BEGIN DAM FAILURE AT 0.00 HOURS

PEAK OUTFLOW IS 746. AT TIME .19 HOURS

SUMMARY OF DAM SAFETY ANALYSIS

NABAW HILL RESERVOIR DAM - BREACH ROUTED SOUTH

PLAN 1 INITIAL VALUE 262.20 SPILLWAY CREST 262.20 TOP OF DAM 262.20
 ELEVATION 58. STORAGE 0. OUTFLOW 0.

RATIO OF PMF .00 MAXIMUM RESERVOIR W.S.ELEV 262.15 MAXIMUM DEPTH OVER DAM 0.00 MAXIMUM STORAGE AC-FT 58. MAXIMUM OUTFLOW CFS 746. DURATION OVER TOP HOURS 0.00 TIME OF MAX OUTFLOW HOURS .19 TIME OF FAILURE HOURS 0.00

ROUTED OUTFLOW

PLAN 1 STATION DS-S

RATIO .00 MAXIMUM FLOW,CFS 736. MAXIMUM STAGE,FT 239.8 TIME HOURS .25

FLOW THROUGH PASSAGE AREA

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	MA	111	NEW	CONGR DIST	STATE	MA	017	04	NAME	WARAN HILL RESERVOIR	LATITUDE (NORTH)	4220.2	LONGITUDE (WEST)	7110.9	REPORT DATE	DAY	MO	YR
IDENTITY NUMBER	MA	111	NEW	CONGR DIST	STATE	MA	017	04	NAME	WARAN HILL RESERVOIR	LATITUDE (NORTH)	4220.2	LONGITUDE (WEST)	7110.9	REPORT DATE	DAY	MO	YR

POPULAR NAME	WARAN HILL RESERVOIR
NAME OF IMPONDMENT	WARAN HILL RESERVOIR
REGION/BASIN	RIVER OR STREAM
NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	NEWTOWN
POPULATION	91100

TYPE OF DAM	REFMPG	YEAR COMPLETED	1900	PURPOSES	S	STRUCTURAL HEIGHT (FT)	26	HYDRAULIC HEIGHT (FT)	26	IMPONDING CAPACITIES (ACRE-FT)	56	POPULATION	91100
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DIST OWN FED M PRV/FED SCS A VER/DATE
NED N N N : N

REMARKS													
ONLY 4 FT OF WATER IN RESERVOIR AT TIME OF INSPECTION													
U.S. HAS LENGTH (FT)	1	1100	SPILLWAY	MAXIMUM DISCHARGE (CY)	15000	VOLUME OF DAM (CY)	15000	POWER CAPACITY (KW)	53	NAVIGATION LOCKS	NO	LENGTH (FT)	53

OWNER	ENGINEERING BY	CONSTRUCTION BY
METRO DISTRICT COMM	METRO DISTRICT COMM	UNKNOWN
DESIGN	CONSTRUCTION	OPERATION
NONE	NONE	MA DEGE
INSPECTION BY	INSPECTION DATE	AUTHORITY FOR INSPECTION
JORDEN & GEPE ENGINEERS INC	23 OCT 79	PL 92-367

REMARKS	
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END

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